

**Before the  
FEDERAL COMMUNICATIONS COMMISSION  
Washington, D.C. 20554**

In the Matter of	)	
	)	
Comment Sought on Competitive Bidding	)	
Procedures for Broadcast Incentive Auction	)	AU Docket No. 14-252
1000, Including Auctions 1001 and 1002	)	
	)	
Expanding the Economic and Innovation	)	GN Docket No. 12-268
Opportunities of Spectrum Through Incentive	)	
Auctions		

**REPLY COMMENTS OF COMMUNICATIONS TECHNOLOGIES, INC.**

**INTRODUCTION**

Communications Technologies, Inc. ("CTI") herein submits its Reply Comments to the above captioned Proceedings wherein the Federal Communications Commission ("FCC") seeks to investigate possible enhancements to the auction process which will increase broadcaster participation and result in the ultimate allocation of TV broadcast channels in a manner that promotes efficient use of the spectrum with minimum interference. CTI is a broadcast engineering consulting firm formed in 1985 and which has practiced before the FCC continuously since its inception. During that time period the firm has filed hundreds of FCC applications for construction permit and license for both commercial and non-commercial radio and TV broadcast stations and participated in numerous Rule Making proceedings.

### **SUPPORT OF COMMENTS FILED – MARKET VARIATION**

CTI has reviewed Comments filed by Sinclair Broadcast Group, Inc. (“Sinclair”) in GN Docket No. 12-268, February 20, 2015, and cites the following portion of Sinclair’s Comments:

“Market variation in the form proposed in the Comment PN does not comply with the FCC’s obligation under the Spectrum Act to use all reasonable efforts to preserve broadcast coverage area and population served as determined by OET-69. It is one thing for the FCC to provide for repacking of stations in or adjacent to the wireless bands in extraordinary or unforeseeable cases. It is quite another thing for the FCC to design an auction that institutionalizes stranded broadcast stations – stations whose present and future coverage cannot be determined according to OET-69 – as fixtures of the spectrum landscape. This simply does not comply with the Spectrum Act’s “all reasonable efforts” mandate.”

CTI strongly believes that a primary focus on a national band plan will result in the minimum number of DTV stations being placed in the adjacent wireless band and subject to complex interference resolution concerns with wireless.

### **SUPPORT OF COMMENTS FILED – DYNAMIC RESERVE PRICING**

CTI supports Comments filed by Sinclair and others concerning Dynamic Reserve Pricing (“DRP”). At footnote 11 of its February 20, 2015 Comments Sinclair states, “But it must be an actual, published reserve price and the auction itself must be competitive. Under the process proposed in the Comment PN, the FCC would not actually adopt a reserve price – it simply reserves the right to reject a transaction after the FCC’s own bid has been accepted. In a true reserve price auction, once the reserve price has been met, the transaction closes at the final bid price that is accepted.” Sinclair’s description of a true reserve price auction describes a fair and open process which will encourage station participation.

CTI favors the proposal by the Expanding Opportunities for Broadcasters Coalition (“EOBC”) who suggests an alternative they call Round Zero Reserve (“RZR”) pricing to accomplish the same

outcome. This is believed to be much simpler, resulting in better participation and ultimately greater clearing.

#### **SUPPORT OF COMMENTS FILED – CALCULATION OF STATION VOLUME**


In AU Docket No. 14-252, in an explanatory letter filed on March 4, 2015, the EOBC explained that its Compromise Proposal preserves the fundamental structure of the Commission's proposal while modifying the exponent of the population factor from 0.5 to 0.25 while leaving the exponent of the interference set at 0.5. CTI supports the EOBC proposal as it puts greater weight on interference which is believed a truer expression of station value in the auction process. CTI also supports the EOBC proposal based on that entities analysis which shows higher opening prices for all TV stations.

#### **SUPPORT OF COMMENTS FILED – IN BAND INTERFERENCE CONCERNS**

The February 20, 2015 Comments in GN Docket no. 12-268 by Donald G. Everist, PE on behalf of Cohen, Dippell and Everist references work by Charles Rhodes written in TV Technology magazine. Attached is a copy of Mr. Rhodes article found in the November 7, 2014 issue of TV Technology titled "The FCC's DTV Interference Dilemma". In this article Mr. Rhodes discusses interference in a TV receiver when two or more UHF stations operate on adjacent channels and deliver strong signals to the TV receiver front end. The interference is described as having two forms. First, increased noise which can mask TV station signals on adjacent channels making them unable to be received. Second, receiver desensitization caused by the presence of strong TV signals. The impact here is across the entire UHF TV band and the potential loss of TV station reception previously enjoyed. These problems are partially related to the need to pack signals closer together in a narrower slice of spectrum and could be exacerbated if more broadcasters come to one central site.

CTI urges the FCC to investigate and consider the potential for receiver induced interference in the repacking process to minimize loss of TV reception as well as interference complaints from adjacent channel wireless users.

Respectfully Submitted,



By \_\_\_\_\_

**Clarence M. Beverage** *for*  
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March 13, 2015

## The FCC's DTV Interference Dilemma

11/7/2014

By now, almost everyone knows the National Association of Broadcasters is suing the Federal Communications Commission over rules for the TV spectrum auction and channel repack in 2016. This suit concerns the procedures by which the FCC will calculate the number of persons affected by co-channel (CC) and/or adjacent channel interference (ACI).

There is another class of interference by undesired (U) signals on other channels. Some of these are known from the days of analog TV in the UHF band as taboo channel interference (TCI). Recently we covered interband interference (IBI), which always involves two or more U signals.

About four years ago this column discussed a specific kind of IBI, frequency modulation interference (FMI). The second harmonics of FM radio signals (88–108 MHz) fall in the high VHF band (174–216 MHz). When the tuner of a DTV receiver is overloaded by one strong FM radio signal, only the second harmonic of that FM signal can cause jamming of a VHF signal on Chs. 7–13. When there are two strong FM signals, the second harmonics of each may be generated in the tuner of DTV receivers. In addition to these harmonics new frequencies will also be generated in the tuner.



Charles W. Rhodes

These are of the form  $2*Fa-Fb$  and  $2*Fb-Fa$ ; and two other third-order inter-modulation products (IM3), which are also generated ( $2*Fa+Fb$  and  $2*Fb+Fa$ ). The latter do not fall in any of our TV bands so they are usually ignored in the literature, but these can cause IBI. As you see, FMI is one form of IBI. This column recently showed that two strong high VHF band (174–216 MHz) signals may generate IM3 of the form  $2*Fa+Fb$  and  $2*Fb+Fa$  that fall in the portion of the UHF band that will remain broadcast spectrum after repacking.

What if there are three high VHF band signals ( $Fa$ ,  $Fb$ , and  $Fc$ )? These generate IM3, which fall in the UHF band:

$2*Fa+Fb$ ,  $2*Fb+Fc$ ,  $2*Fc+Fa$   
 $2*Fb+Fa$ ,  $2*Fc+Fb$ ,  $2*Fa+Fc$

They also generate another class of intermodulation products: triple beats (TB). These are of the form  $Fa+Fb \pm Fc$ . If all three signal frequencies are additive, the TB frequency is about three times higher in frequency—and in the case of three high VHF signals—the TBs fall in the UHF band.

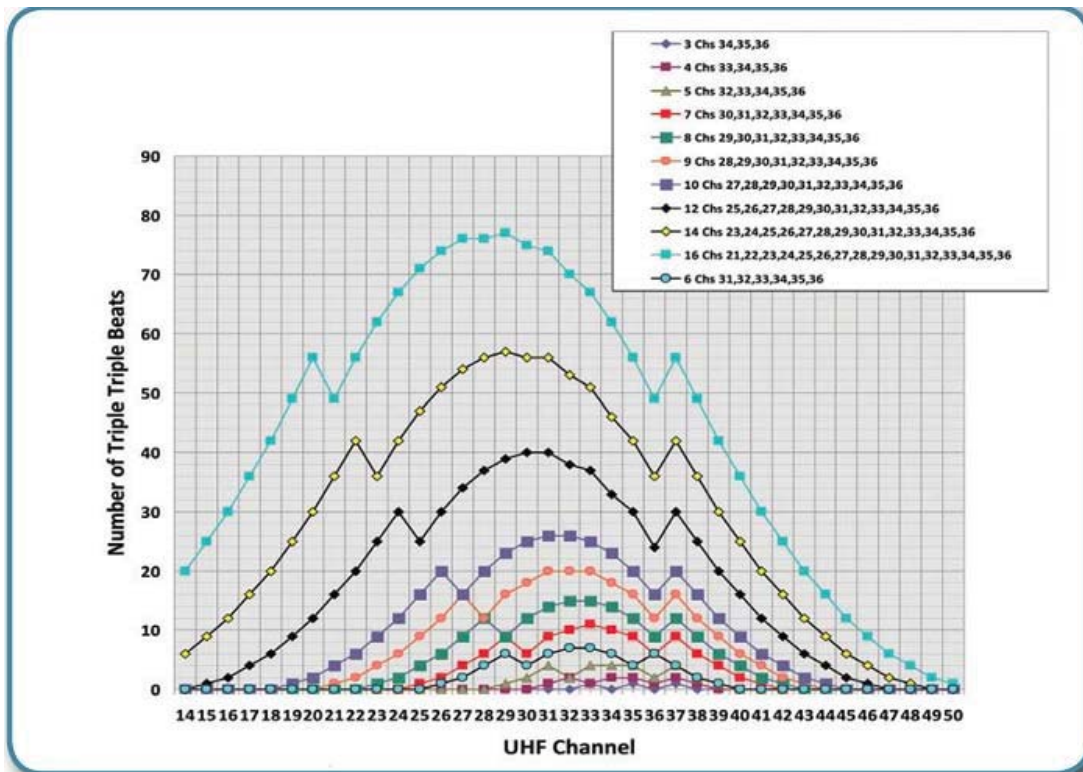


Fig. 1: Number of triple beats per channel for various allocations

Now let us look at TBs generated by three strong U signals in the UHF band. These are of the form:  $Fa+Fb-Fc$ ,  $Fb+Fc-Fa$  and  $Fc+Fa-Fb$ . Note that any one of these can be subtracted from the sum of the other two. Fig. 1 shows the number of TBs for a range of U signals involved.

Four signals generate 10 TBs. For example, consider U signals on Chs. 33, 34, 35 and 36. The spectrum of these IM3 extends from Chs. 30–39 ( $581 + 587 - 599 = 569$  MHz, Ch. 30).  $608$  plus  $602 - 584 = 626$  MHz (Ch. 39) as shown in Fig. 1:

- Five U on Chs. 32–36 produce 13 TB (Ch. 28–40);
- Seven U on Chs 31–36 produce 19 TBs (Ch. 24–41).

Each TB has about 6 dB more noise power than an IM3 being generated by these signals.

My colleague Stanley Knight ran these calculations and also plotted the total noise power in each channel by the IM3 and TBs for each set of U channels as shown in Fig. 2. This needs some further explanation.

Starting with four U signals on Chs. 33–36 there are 10 TBs and a smaller number of IM3. Both TBs and IM3 occupy three consecutive channels. The upper side channel and the lower side channel are about 6 dB weaker than the center channel of an IM3. We found that the noise in Ch. 30 is 3 dB greater than IM3, but Chs. 32 and 34 suffer 9 dB of noise. Ouch!

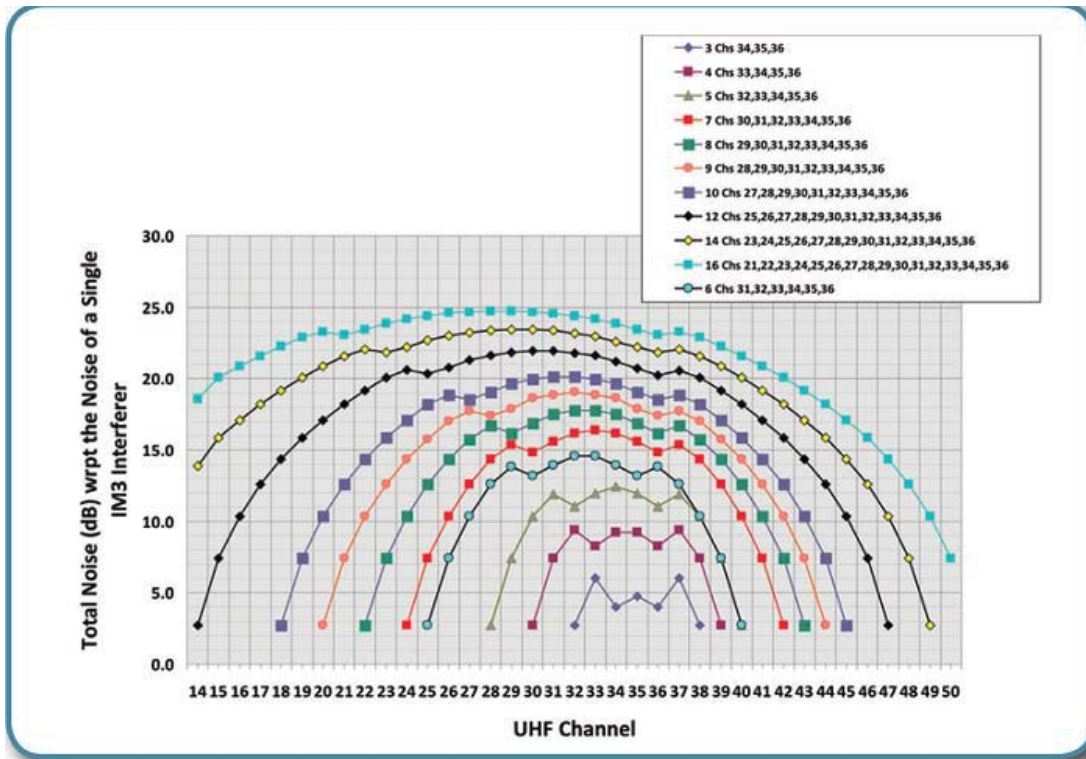


Fig. 2: Noise power spectrum of triple beats and their sides, and IM3 beats and their sides relative to the noise of a single IM3 interferer per channel for various allocations

Now look at the curve for seven U channels (30–36). The noisiest channel has a noise floor 16 dB above what a signal IM3 would have produced.

The reason why there is so much noise dumped into channels by a large number of U signals is that the number of TBs grows almost exponentially with the number of U signals. This is shown in Fig. 2.

### RECEIVER DESENSITIZATION

That is the larger half of the misery. The smaller half is due to desensitization of DTV receivers when there are strong (overloading) U signals present. Desensitization results when the wide band AGC System (widely if not universally used in all DTV receivers, not just ATSC receivers), senses the mixer is being overloaded by the total power of multiple strong U signals, and thus, lowering the gain of the RF amplifier. But of course this also attenuates the desired (D) signal power at the mixer. That is automatically compensated for by increased IF amplifier gain. Alas, the increased IF gain also means that mixer noise at the second detector is increased and there goes the signal-to-noise ratio. If it goes below 15.2, dB reception fails.

### CONCLUSION

While the FCC certainly intends to take into account the effects of CCI and ACI in its planning for repacking, it will not take into account any of the other forms of interference. This column has shown that there are many forms of interference other than CCI and ACI for DTV receivers. You might say that DTV receivers should not use this wideband RF AGC System. However, it must be used to meet the ACI limits, which the FCC has rightly imposed.

Since about 2012 most DTV receivers have a tuner built on a silicon chip and IC. This greatly restricts the RF selectivity of modern DTV receivers. You just cannot put high Q factor inductors on a chip.

Someday a new technology for fabricating filters may come into use in consumer products such as DTV receivers, but there is an existing population of nearly 100 million modern ATSC receivers out there. Perhaps 25 million of those receive signals from an antenna at the residence. How many of them will lose one or more channels due to interference that the FCC had to ignore to proceed with its mandate from Congress to auction TV spectrum for the public good? It is possible that the NAB may choose to amend its suit to add some of the other sources of interference in its lawsuit or others may also sue. Stay tuned.

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